FINAL REPORT

1 General Information

DFG reference number: BR 4979/2-1

Project number: 471335227

Project title: Regionale Industrialisierung in (Südwest-)Deutschland: Verläufe, Diffusion und langfristige Effekte

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Summary

Germany's rapid industrialization in the mid-to-late 19th century marked a significant turning point in its economic development. New technologies and production methods spread, new industries emerged, and the transition to modern economic growth occurred. Additionally, mortality and fertility rates declined dramatically, resulting in a new demographic equilibrium. A core characteristic of these transformative processes was their regional variation. Understanding these regional differences is essential for appreciating the Industrial Revolution as one of the most significant turning points in human history. Against this background, the project aimed to analyze three key aspects of regional industrialization in Germany: (1) the diffusion of steam technology at the plant level, (2) the micro-geography of the demographic transition at the parish level and its economic causes, and (3) the long-term consequences of regional industrialization processes for economic development.

One key outcome of the project is a parish-level demographic dataset for Württemberg (1871–1946), containing annual data on births, deaths, marriages and related statistics. This data can be linked to socio-economic data on religious composition, sectoral employment or voting behavior, for example. Using this novel data and comparing neighboring parishes that differ only in their religious affiliation, the project demonstrates that Protestant parishes experienced the fertility transition about ten years earlier than Catholic ones. Extending the empirical approach to voting behavior, the project shows how confessional politics—with a strong voting norm for the Catholic Center Party among Catholics and a fragmented center-right among Protestants—increased political fragmentation in the Weimar Republic and partially immunized Catholics from voting for the Nazi Party. A second key outcome of the project is demonstrating that 19th-century industrialization has had a critical impact on the evolution of economic prosperity across German regions over the past 100 years. The project documents that almost half of the West German regions experienced reversals in income rank between 1926 and 2019, with early access to coal-driven industrialization ultimately reducing postwar per capita income by fostering a firm structure that hindered adaptive capacity and local innovation. The time-varying effect of early industrialization, initially conducive and later detrimental to prosperity, explains most of the decline in regional inequality in the 1960s and 1970s and about half of the current North–South economic development gap.

Mit der rasanten Industrialisierung Deutschlands seit der Mitte des 19. Jahrhunderts ging ein tiefgreifender Strukturbruch einher. Neue Technologien und Produktionsformen breiteten sich aus, neue Industrien entstanden und der Übergang zum modernen Wirtschaftswachstum erfolgte. Zudem sanken Sterblichkeit und Fertilität und ein neues demografisches Gleichgewicht entstand. Diese Transformationsprozesse waren regional sehr unterschiedlich ausgeprägt. Die empirische Beschreibung und Analyse dieser regionalen Unterschiede sind essenziell für unser Verständnis der Industriellen Revolution als einem der zentralen Wendepunkte in der Menschheitsgeschichte. Vor diesem Hintergrund zielte das vorliegende Projekt darauf ab, drei zentrale Aspekte der regionalen Industrialisierung in Deutschland zu analysieren: (1) die Diffusion der Dampftechnologie auf Betriebsebene, (2) die Mikrogeographie des demographischen Wandels auf Gemeindeebene und (3) die langfristigen wirtschaftlichen Folgen regionaler Industrialisierungsprozesse.

Ein zentrales Ergebnis des Projekts ist ein demografischer Datensatz auf Gemeindeebene für Württemberg (1871–1946), der jährliche Daten zu u.a. Geburten, Sterbefällen und Eheschließungen beinhaltet. Diese Daten können mit sozioökonomischen Informationen etwa zur Religionszugehörigkeit, zur sektoralen Beschäftigung oder zum Wahlverhalten verknüpft werden. Anhand dieser neuen Datenbasis und durch den Vergleich benachbarter Gemeinden, die sich nur in ihrer Religion unterscheiden, zeigt das Projekt, dass der demografische Übergang in protestantische Gemeinden im Durchschnitt etwa zehn Jahre früher stattfand als in katholischen. Mithilfe des gleichen empirischen Ansatzes zeigt das Projekt ferner, wie die Gegensätze zwischen den Konfessionen die politische Fragmentierung in der Weimarer Republik verstärkten. Ein zweites wichtiges Ergebnis des Projekts ist der Nachweis, dass die Industrialisierung im 19. Jahrhundert einen entscheidenden Einfluss auf die Entwicklung des wirtschaftlichen Wohlstands deutscher Regionen in den letzten 100 Jahren hatte. Anfangs profitierten die früh industrialisierten Regionen in der nördlichen Landeshälfte. Ab den 1950er Jahren stellten sich genau diese Regionen aber als weniger anpassungsfähig heraus als solche im stärker diversifizierten Süden. Seitdem wirkt sich frühe Industrialisierung nachteilig aus. Regionale Unterschiede in der Frühindustrialisierung erklären demnach den größten Teil des Rückgangs der regionalen Ungleichheit in den 1960er und 1970er Jahren und etwa die Hälfte des aktuellen wirtschaftlichen Entwicklungsgefälles zwischen Nord- und Süddeutschland.

2 Progress Report

- Background and objectives of the project

Germany's rapid industrialization in the mid- and late 19th century represented a profound structural shift in its economic development. New technologies and production methods spread, new industries emerged, and the transition to modern economic growth occurred. At the same time, mortality and fertility rates declined dramatically, resulting in a new demographic equilibrium. A core characteristic of these transformation processes is that they varied greatly from region to region. Understanding these regional differences is essential to grasping the Industrial Revolution as one of the central turning points in human history. Against this context, the project aimed to analyze three central yet under-researched aspects of regional industrialization in Germany:

(1) the diffusion of steam technology at the plant level;
(2) the microgeography of the demographic transition at the parish level and its economic causes; and
(3) the long-term consequences of regional industrialization processes on economic development in the 20th and 21st centuries.

To this end, the project aimed at compiling detailed new datasets providing information at a more detailed regional level than existing sources on regional industrialization in Germany. The project had a specific focus on 19th and early 20th century Württemberg, whose late and decentralized industrialisation, dominated by small and medium sized enterprises, is often cited as a key factor in the region's rise to one of Germany's economic powerhouses in the 20th century.

- Project-specific results and findings

In what follows, I discuss, in reverse order, project-specific results on the three aspects listed above.

(3) Long-term consequences of regional industrialization processes

Cooperation partner: Paul Berbée (ZEW – Leibniz-Zentrum für Europäische Wirtschaftsforschung); Richard Franke (Trinity College Dublin)

In work recently published in the *Journal of Economic Growth* (Berbée, Braun and Franke, 2025a), we show that 19th-century industrialization is an essential determinant of the pronounced changes in economic prosperity across German regions over the last 100 years. Using novel data on economic activity in 163 labor market regions in West Germany, we find that nearly half of them experienced a reversal of fortune, moving from the lower to the upper median of the income distribution or vice versa, between 1926 and 2019. Exploiting plausibly exogenous variation in access to coal, we show that early industrialization led to a massive decline in the per capita income rank after World War II, as it turned from an asset to economic development into a liability. We present evidence consistent with the view that early industrialization created a lopsided economic structure dominated by large firms, which reduced adaptive capacity and local innovation. The (time-varying) effect of industrialization explains most of the decline in regional inequality observed in Germany in the 1960s and 1970s and about half of the current North-South gap in economic development.

Our results have several important implications for the policy discourse on regional inequality and economic decline. First, our results imply that interpreting recent shifts in regional inequality (e.g., Iammarino et al. 2018) requires careful attention to historical legacies, since past development can have lasting effects. Second, we show that initial gains from industrialization may entail long-run losses (Matheis 2016; Franck and Galor 2021), raising the question of whether policy can avert adverse outcomes—for example, by establishing universities in former industrial regions to mitigate skill shortages (Esposito and Abramson 2021). Third, our results suggest that early industrialization's creation of a lopsided economy dominated by large firms in heavy industries can hinder entrepreneurship and growth (Glaeser et al. 2015; Stuetzer et al. 2016). Therefore, a more diversified structure—as in Italy's industrial triangle (Fenoaltea 2003)—might avoid such negative long-term effects.

Handling of Research Data: In line with the project application (WP3), we have compiled regionally disaggregated data on three-digit industrial employment in the German Empire from the trade censuses (Gewerbezählung) of 1895 and 1907. The data records information on counties (*Kreise*). We delegated the data entry to an external supplier, providing the supplier with template spreadsheets. Checksum algorithms were used to cross-validate the data entry. In Berbée, Braun and Franke (2025a), we used the data to measure early industrialization and industry concentration. Data and replication code used in the paper are available online (Berbée, Braun and Franke, 2025b).

Moreover, we have teamed up with Luis Bosshart (LSE), Felix Kersting (Humboldt-Universität zu Berlin), and Matthias Weigand (Harvard University) to create a public database that contains county-level data on employment by three-digit occupations (from the occupa-

tion censuses) and by three-digit sectors (from the business censuses) for the German Empire. Our DFG project's digitization efforts will provide data for 1895 and 1907, and we will complement these data with similar information for 1925, 1933 and 1939. Bringing these data together in one place, along with crosswalks for the sectors and occupations, will provide a major public good for the profession. As the digitization process is almost complete, we expect to publish the database by the end of 2025.

Follow-up work: In follow-up work, we plan to use the database (and potentially extend it until today) to provide a descriptive analysis of the spatial distribution of emerging and later declining industries in Germany.

(2) Microgeography of the demographic transition

Cooperation partner: Richard Franke (Trinity College Dublin)

In line with the project application (WP2), we have constructed a novel database of vital and marriage statistics for all localities in Württemberg from 1871 to 1946. Sources are archival records in the Staatsarchiv Ludwigsburg (E 258 VII Bü 118-122). Table 1 below gives an overview of the data (see the point data handling for further details). In our research, we link the dataset to parish-level information on population, religious composition, sectoral employment, and other economic indicators.

Table 1: Parish-level demography data for Württemberg

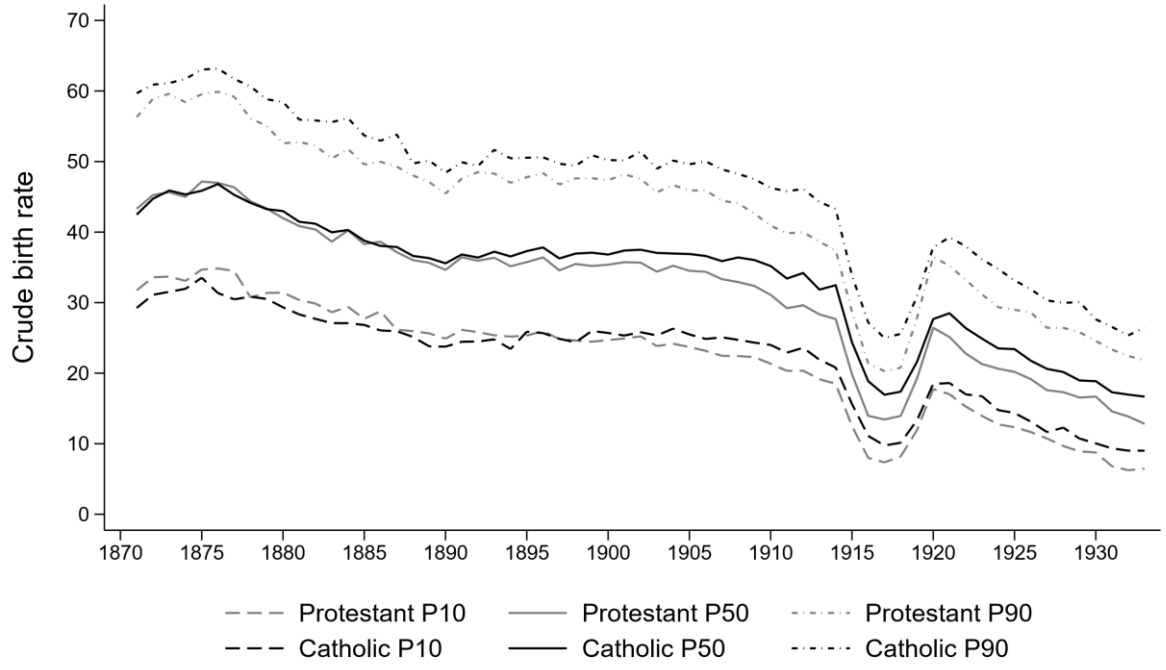
Statistics	Years
Births	1871-1946
Deaths	1871-1946
Deaths before the first year of life	1871-1946
Marriages	1871-1946
Out-of-wedlock births	1871-1946
Stillbirths	1871-1930
WWI deaths	1914-1933

Protestantism, Industrialization, and the Fertility Decline

In an ongoing project[1], we use the data to provide the first large-scale descriptive evidence on the timing of fertility decline at the parish level for Germany. We find that there is as much heterogeneity in the timing of fertility decline within Württemberg as there is across districts in Europe.

We then go on to provide evidence on the effect of religious denomination on the timing of the fertility decline. Figure 1 illustrates the scope of the data: It shows annual crude birth rates at the 10th, 50th, and 90th percentile for 1871-1933, separately for Catholic and Protestant parishes. In the early 1870s, Protestant parishes have higher fertility rates than their Catholic counterparts at the 10th percentile, while the opposite is true at the 90th percentile. This pattern does not disappear until the late 1890s, after which Protestant parishes also have lower fertility rates at the lower end of the distribution. On average, Protestant parishes go through the fertility decline about ten years earlier than Catholic parishes.

Figure 1: Crude birth rates at 10th, 50th, and 90th percentile in Württemberg parishes by religious affiliation, 1871-1933[2]

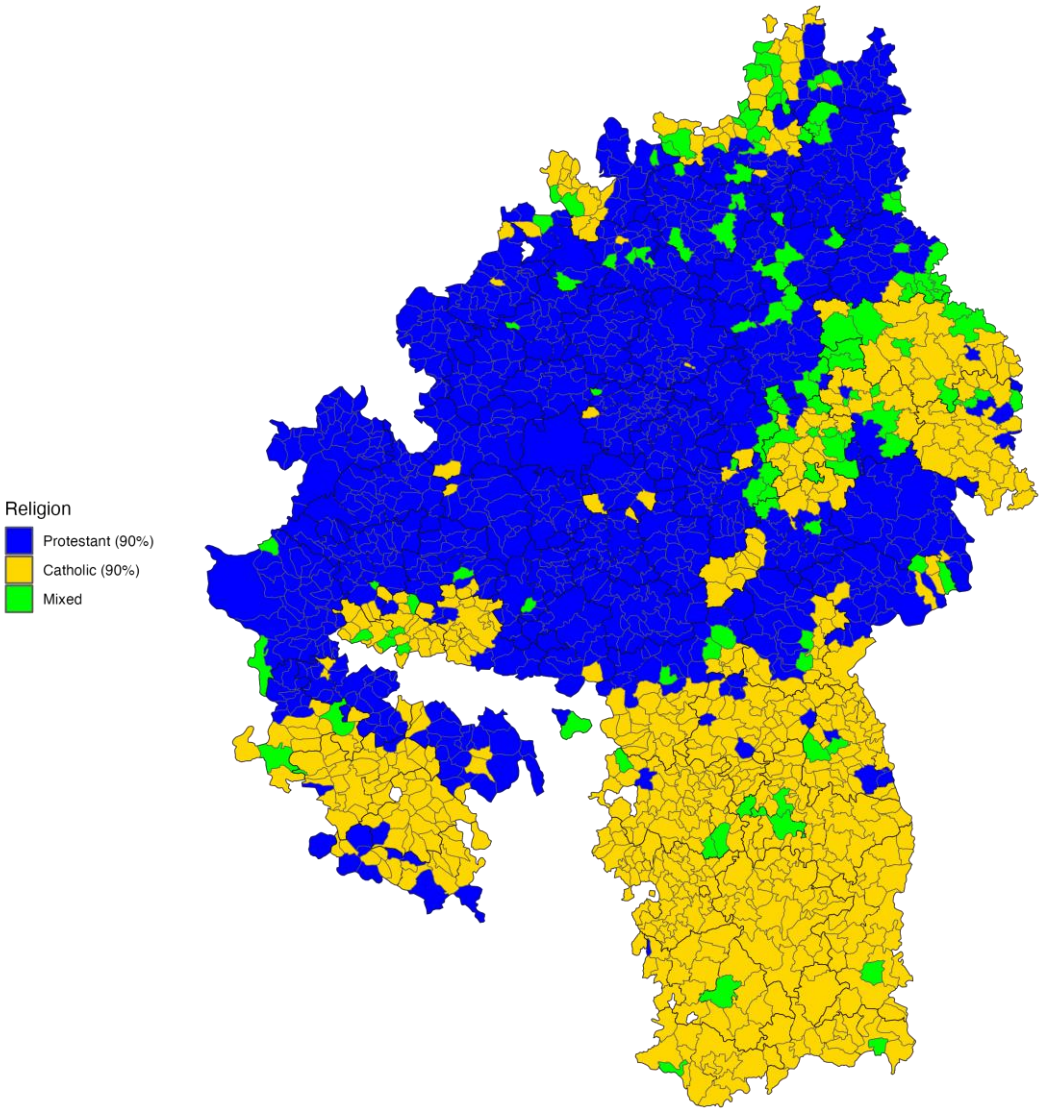


To provide causal evidence on the effects of Protestantism, we compare neighboring parishes with different religious compositions in order to address concerns about omitted variable

[1] Braun, S.T., Franke, R., & Öztürk, T. Protestantism, Industrialization, and the Fertility Decline: Evidence from Religious Enclaves in Württemberg, 1871-1933. University of Bayreuth, mimeo.
[2] Note: Own calculations based on Braun, Franke, & Öztürk (2025).

bias. Our empirical strategy takes advantage of the fact that, after 1555, local rulers determined the local religion in the German lands ("cuius regio, eius religio"). Southwest Germany had more than 250 territories in the pre-Napoleonic era, so this principle created many adjacent Catholic and Protestant areas (see Figure 2). We demonstrate that these adjacent regions differ only in terms of religion, not in geographic or other pre-existing characteristics.

Figure 2: Majority religion in Württemberg parishes, 1871[3]



Our results support a causal interpretation of our finding that religious denomination had a comparatively large influence on the timing of the fertility transition. We present evidence

[3] Source: Own calculations based on Statistisches Landesamt Baden-Württemberg (2008). A mixed parish is one in which fewer than 90% of the population belongs to the majority denomination.

refuting the hypothesis that Protestantism accelerated fertility decline by accelerating economic modernization. Instead, we argue that the key mechanism is an interaction between religious norms, secularization, and differential responses to changes in infant mortality.

Confessional Politics, Political Fragmentation, and the Nazi Electoral Breakthrough

In a second, ongoing project[4] that was not included in the original application, we supplement our parish-level data from Württemberg with data from Baden. Using a similar empirical strategy as in the demography project, we examine the impact of Protestant-Catholic antagonism on political fragmentation in Weimar Germany and the Nazi electoral breakthrough in 1932. Our conceptual framework illustrates how confessional politics—with a strong voting norm for the Catholic Center Party among Catholics and a fragmented center-right among Protestants—increased political fragmentation in the Weimar Republic and partially immunized Catholics from voting for the Nazi Party. Using our parish-level data from the German Southwest, we test and confirm these predictions, again using the historical religious divide between neighboring parishes for identification. Finally, we examine whether the formation of the pan-denominational Christian Democratic Union was able to overcome the confessional divide in voting after World War II. We demonstrate that Protestant-Catholic antagonism declined in the postwar decades, only to resurface in the late 1960s, when Protestant parishes again recorded much higher vote shares for the right-wing extremist NPD party.

Handling of Research Data: During multiple visits to the Staatsarchiv Ludwigsburg, we researched the available demographic data at the parish level and obtained scans of the data sources. We then created template spreadsheets to facilitate data entry and linkage across parishes and years. An external service provider performed the data entry using the templates. We cross-validated the data entry using checksum algorithms. The data has been published in a public repository (Braun, Franke and Öztürk, 2025) openly accessible to others. The readme file contains additional information on the dataset.

Delay and Status of Research Papers: Contrary to the original time schedule, the two papers described above have not yet been finalized and submitted. There are two main reasons for the delay. First, during a relatively early phase of the project, our work in Berbée et al. (2025a), which is part of the project, was twice requested for re-submission to the *Journal of Economic Growth*. While a great success, the required revisions were extensive and con-

[4] Braun, S.T. & Öztürk, T. Confessional Politics, Political Fragmentation, and the Nazi Electoral Breakthrough. University of Bayreuth, mimeo

sumed significant project resources. Second, aligning the parish borders for our relatively long time frame of 1871 to 1946 took much more time than anticipated. Despite the delay, the papers are now at an advanced stage and have been presented multiple times at national and international seminars and conferences (see Conference and Seminar Presentations). We anticipate publishing the two papers as working papers by the end of the year and submitting them to refereed journals thereafter.

(1) The diffusion of steam technology at the plant level

For this part of the project, we aimed to create a new database of all 1,100 steam engines installed in Württemberg between 1840 and 1869, linking the data to other plant-level data from that period. Our goal was to use this data to study plant-level decisions regarding the adoption of steam in Württemberg since 1840. Unfortunately, digitizing the handwritten information from the archival records, other than the standardized information on location, year of installation, and horsepower, proved to be much more time-consuming than anticipated. In particular, technical terms and information about the use of steam engines had to be researched and corrected manually. This was because the AI-supported digitization of cursive script (Kurrentschrift) produced unsatisfactory results. Due to the project's overall delay (see our previous discussion), we prioritized work on aspects (2) and (3) (the microgeography of the demographic transition and the long-term consequences of early industrialization) to have tangible results by the project's end.

Conference and seminar presentation:

Throughout the project, we presented our work at national and international conferences and seminars hosted by renowned universities. These presentations provided us with timely feedback from the academic community and allowed us to share our results early on. Below, we provide an overview of the presentations given throughout the course of the project. We have organized the presentations by sub-project and always list the corresponding speaker.

(1) Steam engines

- Transkribus User Conference, Innsbruck, 2022 (Timur Öztürk)
- Bayreuth Young Economists Research Seminar, Bayreuth, 2022 (Timur Öztürk)

(2) Protestantism, Industrialization, and the Fertility Decline

- Graduate Seminar, Bayreuth, 2022 (Timur Öztürk)

- V. Congress for Economic and Social History, Leipzig, 2023 (Timur Öztürk)
- European Historical Economics Society Conference, Vienna, 2023 (Timur Öztürk)
- CEPH/Bayreuth Economic History Workshop, Dublin, 2024 (Timur Öztürk)
- Economic History Society Annual Conference, Newcastle, 2024 (Richard Franke)

(3) Confessional Politics, Political Fragmentation, and the Nazi Electoral Breakthrough

- Graduate Seminar, Bayreuth, 2024, 2025 (Timur Öztürk)
- Bayreuth Young Economists Research Seminar, Bayreuth, 2024, 2025 (Timur Öztürk)
- VI. Congress for Economic and Social History, Berlin, 2025 (Timur Öztürk)

(4) Reversing fortunes of German regions, 1926–2019

- LSE Economic History Seminar, London, 2022 (Richard Franke)
- Royal Economic Society Annual Conference, Manchester, 2022 (Richard Franke)
- Economic History Seminar, UC3 Madrid, 2022 (Paul Berbée)
- Graduate Seminar, Bayreuth, 2022 (Richard Franke)
- Economic History, Growth & Development Seminar, MLU Halle-Wittenberg, 2022 (Richard Franke)
- Verein für Socialpolitik Annual Conference, Regensburg, 2022 (Sebastian Braun)
- DONDENA Seminar, Bocconi University Milan, 2022 (Sebastian Braun)
- Harvard Growth Lab, Research Seminar, 2022 (Sebastian Braun)
- 12th Annual Workshop on Growth, History and Development, Odense, 2023 (Richard Franke)
- RHI Seminar, Wageningen University & Research, 2023 (Richard Franke)
- Royal Economic Society Annual Conference, Belfast, 2024 (Richard Franke)
- WIP Seminar, Trinity College Dublin, 2024 (Richard Franke)
- ECONtribute and C-SEB Seminar University of Cologne, 2025 (Richard Franke)

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Berbée, P., Braun, S.T., & Franke, R. (2025a). Reversing fortunes of German regions, 1926–2019: Boon and bane of early industrialization?. *Journal of Economic Growth* **30**, 307–337. https://doi.org/10.1007/s10887-024-09247-x

Berbée, P., Braun, S.T., & Franke, R. (2025b). Replication Data for: Reversing Fortunes of German Regions, 1926-2019: Boon and Bane of Early Industrialization?, https://doi.org/10.7910/DVN/VEREHV, Harvard Dataverse, V1.

Braun, S.T., Franke, R., & Öztürk, T. (2025). A Parish-Level Database on Vital Demographic Statistics in Württemberg, 1871-1946. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2025-07-30. https://doi.org/10.3886/E236981V1

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Fenoaltea, S. (2003). Peeking backward: Regional aspects of industrial growth in post-unification Italy. *The Journal of Economic History, 63*(4), 1059–1102. https://doi.org/10.1017/S0022050703002535

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Matheis, M. (2016). Local economic impacts of coal mining in the United States 1870 to 1970. *The Journal of Economic History, 76*(4), 1152–1181. https://doi.org/10.1017/S002205071600098X

Statistisches Landesamt Baden-Württemberg (2008). *Volkszählungen in Württemberg 1834 bis 1925*. Statistisches Landesamt Baden-Württemberg.

Stuetzer, M., Obschonka, M., Audretsch, D. B., Wyrwich, M., Rentfrow, P. J., Coombes, M., Shaw-Taylor, L., & Satchell, M. (2016). Industry structure, entrepreneurship, and culture: An empirical analysis using historical coalfields. *European Economic Review, 86*, 52–72. https://doi.org/10.1016/j.euroecorev.2015.08.012

3 Published Project Results

4.1 Category A – Articles in peer-reviewed journals, contributions to peer-reviewed conferences or to anthology volumes, and book publications

Berbée, P., Braun, S.T., & Franke, R. (2025a). Reversing fortunes of German regions, 1926–2019: Boon and bane of early industrialization?. *Journal of Economic Growth* **30**, 307–337. https://doi.org/10.1007/s10887-024-09247-x

4.2 Category B – Any other form of published results

Berbée, P., Braun, S.T., & Franke, R. (2025b). Replication Data for: Reversing Fortunes of German Regions, 1926-2019: Boon and Bane of Early Industrialization?, https://doi.org/10.7910/DVN/VEREHV, Harvard Dataverse, V1.

Braun, S.T., Franke, R., & Öztürk, T. (2025). A Parish-Level Database on Vital Demographic Statistics in Württemberg, 1871-1946. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2025-07-30. https://doi.org/10.3886/E236981V1

4.3 Patents (applied for and granted)

None